The Wielandt machine is similar in principle to the Baumann, but lighter in construction, largely owing to the adoption in it of a different spreading mechanism. The machine can be driven by a 25-h.p. electromotor, and its total cost, including motor and cables, was 1000*l.* four or five years ago, but is now much higher. During the war it was found at Elisabethfehn, in Oldenburg, that one of these machines, attended by one man and three or four youths, had an output in the season of 7000 tons of air-dry turf.

If the statements made abroad with regard to the efficiency of automatic machines are correct, four of these machines, attended by sixteen men in all, can dredge, form into sods, and spread in a day enough peat to yield, when air-dry, about 250 tons of turf. The same output of peat, cut and spread, by the method ordinarily practised in Ireland requires about 160 men. It is therefore a matter of great importance for the winning of peat on a large scale in Ireland that these claims should be subjected to a prolonged test under the conditions obtaining here. In conclusion the writer must again express his regret that the recommendations of the Peat Inquiry Committee were ultimately set aside for reasons which are in part due to misinterpretation of the Peat Committee's report, and in part to statements which were made by the Agricultural Sub-Committee, and are in sharp disagreement with the actual facts, in regard to the extent and the purchase price of Irish bogs.

See also Aug. 18 p.779.

Geophysical Problems.

A SURVEY of research problems in geophysics has recently been published by the American Geophysical Union, a body which acts as the Committee on Geophysics of the National Research Council, and as the United States National Committee of the International Geodetic and Geophysical Union. The survey consists of a series of seven essays by the chairmen of the several sections of the union, dealing respectively with geodesy, seismology, meteorology, terrestrial magnetism and electricity, physical oceanography, volcanology, and geological physics and chemistry. It is interesting to observe that the two latter subjects, so little studied in this country, are in America found sufficiently important to occupy separate sections of the union.

Advance in nearly all these branches of geophysics seems to depend on much the same method of attack, involving on the one hand an enormous amount of organised, co-ordinated labour of observation and measurement, and on the other individual theoretical study, necessarily of a freelance character, by a comparatively few people with scientific training, insight, and wide knowledge, at research institutes or universities. The first half of the task is being executed with increasing skill and success by the national scientific organisations of the leading countries, but the complementary half lags behind. Dr. C. F. Marvin, for instance, after describing the present achievements and future tasks of meteorological organisations, concludes that "seemingly the greatest need in meteorology is that of a master mind to direct itself comprehendingly and intensively to the great problems which the science still presents." The recency of the beginning made by meteorologists in the study of the upper air, now recognised to be fundamental for the upbuilding of a dynamical science of meteorology, suggests that perhaps also in other geophysical sciences progress may be obstructed by failure to perceive vitally important directions which observation and research must take.

The outstanding task of geodesy at the present time is described by Prof. Bowie as being that of co-ordinating the geodetic triangulations of the various countries by reducing them to a single datum, defined as the adopted latitude and longitude of some one station, the azimuth of a line radiating from that station, and the dimensions of the reference spheroid on which the triangulation is computed. This involves a herculean work of re-computation and re-adjustment of the triangulation networks, especially in Europe; in America much progress in this direction has already been made. Gravity surveys must be extended over the land surfaces, and a satisfactory method of observation evolved for the ocean areas of the globe; this will afford information as to the variations of density in the earth's crust, enable the theory of isostasy to be further developed, and thereby lead to ever closer approximations to the figure of the earth.

In seismology the most important world-wide problem is the accurate determination of the time taken by earthquake waves to travel from their origin to other points on the earth's surface; this information is necessary in order that the origin of earthquakes arising in inaccessible (land or oceanic) regions may be determined, and that the velocity and path of the waves within the earth may be deduced, thus throwing light on the earth's internal constitution. Prof. Reid expresses the opinion that the most useful means to this end lies in the improvement of the equipment of existing seismological observatories rather than in multiplication of the present number. The desirability also of methodical studies of limited areas where small shocks are frequent and strong ones occasional is also mentioned, with the view of determining the sequence of events leading up to the rupture producing a strong shock, and possibly of forecasting the region and time of such occurrences.

Dr. Bauer's article on terrestrial magnetism contains some interesting remarks on the progress of the analysis of the earth's magnetic field which is now being made in the department of the Carnegie Institution which he controls. It has been concluded that for many purposes the theoretical formula proceeding in series of spherical harmonics may be restricted to the few most important terms, leaving the residual field, representing continental and more local irregularities, for special study and treatment in accordance with their extent and character. Reference is also made to the important problems afforded by the magnetic variations, both those connected with auroræ and earth-currents, and the rarer ones occurring at times of solar eclipse. The baffling fundamental problems of the origin of the earth's main magnetic field and the cause of its secular variation are also touched upon.

Prof. Littlehales points out the influence which the ocean, being so large an expanse of the substance having the highest known capacity for heat, must exercise as a factor governing the distribution of terrestrial temperature, and the consequent importance of oceanography to geophysics in general. A *résumé* is given of the efforts so far made, by voyages of exploration and by investigations in marine laboratories, towards the study of the oceans in their many aspects; the system according to which progress is now being sought is the study, in detail, of definite oceanic stations periodically revisited every three

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months, for the purpose of making synoptic charts of temperature, salinity, gas content, currents, and so on, which it is hoped will prove amenable as material for mathematical investigation of the related phenomena.

In his essay on volcanology Dr. H. S. Washington describes the information which requires to be collected for the systematic study of the subject, and the programme of a volcanic observing station, such as those which have been established for some years at Vesuvius and Kilauea. The article on geophysicochemical problems, by Dr. R. B. Sosman, of the Carnegie Institution Geophysical Laboratory, concludes the report, and deals with the investigation of the physical properties and chemical reactions of the substances and aggregates which make up the earth.

Agricultural Research.

"THE Present Position of Research in Agriculture" formed the subject of a lecture delivered by Sir Daniel Hall at the Royal Society of Arts, and reported in the society's Journal for April 1 (No. 3567, vol. lxix.). Up to the time of the formation of the Development Commission in 1909, agricultural research was entirely unrecognised by the State. A considerable amount of information had been gained from the researches at the Rothamsted Experimental Station, which was started in 1843, and was entirely dependent on the endowment provided by its originator, Sir John Lawes; valuable researches were also being carried on at the Woburn Station of the Royal Agricultural Society, while from 1890 onwards the various agricultural colleges were commencing investigations along many different lines. To work of this kind the State granted not more than a few hundred pounds a year, and the Development Commission was expressly charged with the object of formulating some scheme for the promotion of research. The scheme adopted is now in working order, and by it the field is divided up into a number of subjects, one of which is allocated to each university or institute. By this means research is removed from immediate State control, concentration of effort ensured, and overlapping avoided, and each institute is able to carry out a continuous scheme of work. The question of the State control of research is one which is hotly debated. On one hand it is argued that the State pays, and therefore should control the expenditure; on the other, when the nature of research work is considered, it is obvious that the looser system of control prevailing in a university is much more productive of good work than the rigid methods of a Government department, while the type of man wanted for research is much more attracted to the former than to the latter. Moreover, if research came directly under Government control, then the programme of work would have to be submitted annually to the judgment and criticism of administrative bodies possessing no expert knowledge. That such a procedure is disastrous has been proved many times in other countries.

Another advantage arising out of the association of the research institutes with the universities lies in the co-operation thereby ensured with other workers in all fields of science, so that no matter in what direction the particular research may extend, the advice of men with expert knowledge is always available. It is also of the utmost importance to keep agricultural research in contact with the business of farming, and this is attained most easily through association with a university which teaches agriculture and is in touch with the surrounding farmers.

At present there are under the scheme eight institutes, each dealing with some particular branch of agricultural research, such as plant pathology, fruit-growing, dairying, etc. A research council, consisting of the directors of the various institutes, together with a few independent scientific men and the officials of the Government departments concerned, has been set up to ensure the co-ordination necessary between the different research centres. To this body also the Ministry is able to submit plans for any large-scale investigations requiring the co-operation of a number of the institutes. An important feature of the scheme has been the provision of a number of advisory officers who are attached to the various agricultural colleges. These men are free from most teaching duties, and are able to give advice and help to the farmers and horticulturists in their area while keeping in close touch with the directors of the related institutes and the officers of the Ministry's staff. In this way a systematic service is secured capable of dealing with plant pathology, etc., all over the country.

The total funds set aside in the current Estimates for this research scheme amount to 105,000*l*., against 38,250*l*. for the year 1913–14. This ensures for each institute a definite number of salaried posts with reasonable prospects of promotion, so that agricultural research is no longer an absolute blind-alley employment.

The immensely important subject of animal disease has been very inadequately dealt with, but the many difficult questions involved are being investigated. The Ministry is now supporting a research laboratory at Addlestone, and grants are made to the Royal Veterinary College and the London School of Tropical Medicine for the pursuance of researches in animal diseases.

Having dealt with the organisation of research, the lecturer gave a short account of some of the most important practical results obtained recently from the various institutes. At Rothamsted a valuable investigation has been carried out on the method of the decomposition of farmyard manure. A cellulose fermenting organism was discovered which attacks straw in the presence of active nitrogen. At the same time there is considerable loss of nitrogen, so that it is most essential to protect the ordinary dung-heap from washing by rain, and also, in the case of rich cake-fed dung, it must be got on to the land early if heavy losses of nitrogen are to be avoided. Some of the principles emerging from this work have been very successfully applied to the treatment of sewage. At present the valuable nitrogenous compounds in sewage are mostly wasted, but by passing it through a straw filter bed under certain conditions some 60 per cent. of the nitrogen is removed by the organisms decomposing the straw, which thereby becomes a good manure, and, moreover, the effluent is harmless. Further trials are in progress with the object of making farmyard manure on a large scale without animals.

At Aberystwyth plant-breeding methods are being applied to grasses and clovers, while at Cambridge the scientific breeding of farm crops has given most valuable results; wheats have been produced which add 10 per cent. to the yield of the farm, while some of them combine the strength of the Canadian with the cropping power of the English varieties.

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